

A New Species of *Nebria* Latreille (Insecta: Coleoptera: Carabidae: Nebriini) from the Spring Mountains of Southern Nevada

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Nebria baumanni Kavanaugh, new species, is described from the Springs Mountains of southern Nevada (type locality: U.S.A., Nevada, Clark County, Spring Mountains, Deer Creek) and is the only known species of the genus endemic to Nevada. It is most closely related to species of the *meanyi* species group based on features of external form and structure and male and female genitalia. This species is named in honor of Dr. Richard Baumann, in recognition of the many contributions by him and his students to our knowledge of arthropod diversity of the Intermountain and Great Basin regions. A key is provided for identification of adults of all *Nebria* species known to occur in Nevada.

KEYWORDS: Coleoptera, Carabidae, Nebriini, *Nebria*, new species, Nevada, Spring Mountains, identification key

Nebria Latreille (1810) is a moderately diverse genus of cool- or cold-adapted carabid beetles restricted to the Holarctic Region and mainly to northern and montane portions of that region. Ledoux and Roux (2005) recorded 384 described species and an additional 158 taxa treated as subspecies in the world's fauna. Since that time, several additional species have been described, including two (Kavanaugh 2008; Kavanaugh and Schoville 2009) from North America. Including the latter, the Nearctic fauna as presently known comprises 85 species, including 31 taxa that previously have been treated as subspecies (Bousquet and Laroche 1993; Bousquet 2012; Kavanaugh 1979, 1981, 1984) but which I now recognize as distinct species.

Recently, I received a few dozen specimens of *Nebria* species from Kipling Will (University of California, Berkeley) for identification. Kip had borrowed most of these specimens from the Monte L. Bean Life Science Museum at Brigham Young University in Provo, Utah, and all were from the state of Nevada. Among those specimens were four from the Spring Mountains of Clark County in southern Nevada that, based on features of external form and structure, were members of the *meanyi* species group. That group currently includes four species: *Nebria giulianii* Kavanaugh (1981), *Nebria lamarckensis* Kavanaugh (1979), *Nebria meanyi* Van Dyke (1925) and *Nebria sylvatica* Kavanaugh (1979). None of these species is known to occur in Nevada, although *N. giulianii* is found in the California portion of the White Mountains, which cross the California-Nevada border and extend a short distance (ca. 15 km) into Esmeralda County, Nevada. So it is certainly possible that *N. giulianii* may occur in suitable habitat (permanent streams or seeps at elevations above 2300 m, if any exist) on the north or northeast slopes of that range, particularly in the vicinity of Boundary Peak.

Although clearly very similar to members of the other *meanyi* group species, the series of four specimens from the Spring Mountains demonstrated several consistent differences from all of them

in external features. Subsequent detailed examination of male and female internal reproductive structures revealed marked differences from members of the previously described species, and provided strong evidence that this series represents a new, undescribed species. The purpose of this paper is to describe this new species of *Nebria*. A key is provided for identification of adult specimens of all *Nebria* species, including this new one, known to occur in the state of Nevada.

MATERIALS AND METHODS

This report is based on study of the four specimens from the Spring Mountains, described here as representing a new species, and tens of thousands of additional specimens representing all previously described Nearctic *Nebria* species. Codons used in the text for collections in which specimens have been deposited include:

BYUC — Monte L. Bean Life Science Museum, Brigham Young University, Provo, UT 84602

CAS — California Academy of Sciences, 55 Music Concourse Drive, San Francisco, CA 94118

Methods used in the present study conform to criteria for ranking taxa as distinct species and techniques for handling specimens as described in Kavanaugh (1979)

Measurements: The only measurement here used is standardized body length (SBL), which equals the sum of the lengths of the head (measured from apex of clypeus to a point on midline at level of posterior margin of compound eye), pronotum (measured from apical margin to basal margin along midline), and elytra (measured along midline from apex of scutellum to apex of the longer elytron).

Dissections: Both male and female genitalia were extracted from specimens relaxed in water immediately after it had boiled and to which a few drops of liquid detergent had been added. Genitalic preparations were then cleared in hot 10% potassium hydroxide solution for five to 10 minutes, each constantly monitored to achieve only a useful degree of clearing. They were then rinsed briefly in 10% acetic acid and then repeatedly in distilled water. Preparations of female genitalic structures were next lightly stained with Chlorazol Black E® (Kodak Corporation). After examination, preparations were stored in glycerin in polyethylene microvials and pinned beneath their specimens of origin.

Illustrations: Digital images of whole specimens and particular structures were taken using a Leica imaging system including an M165C dissecting microscope, DFC550 video camera, and two KL1500 LCD light sources. Stacked images were captured and combined into single montage images using the Leica Application Suite V4.2.0. Plates of images were created using Adobe Photoshop CS5.

SYSTEMATICS

Nebria baumanni Kavanaugh, new species

Figures 1, 2A, 3A, 4A, 5A-B, 6A, 7

TYPE MATERIAL.— Holotype (Fig. 1), a male, deposited in CAS, labeled: “NV Clark Co. Deer Crk Spring Mtns 9 June ’82 Baumann-Clark”/ “HOLOTYPE: *Nebria baumanni* Kavanaugh sp. nov. 2015” [red label]/ “California Academy of Sciences Type No. 18992”. Paratypes (total of 3): 2 females in BYUC and 1 female in CAS with same locality label as holotype, but with the following label: “PARATYPE: *Nebria baumanni* Kavanaugh sp. nov. 2015” [yellow label].

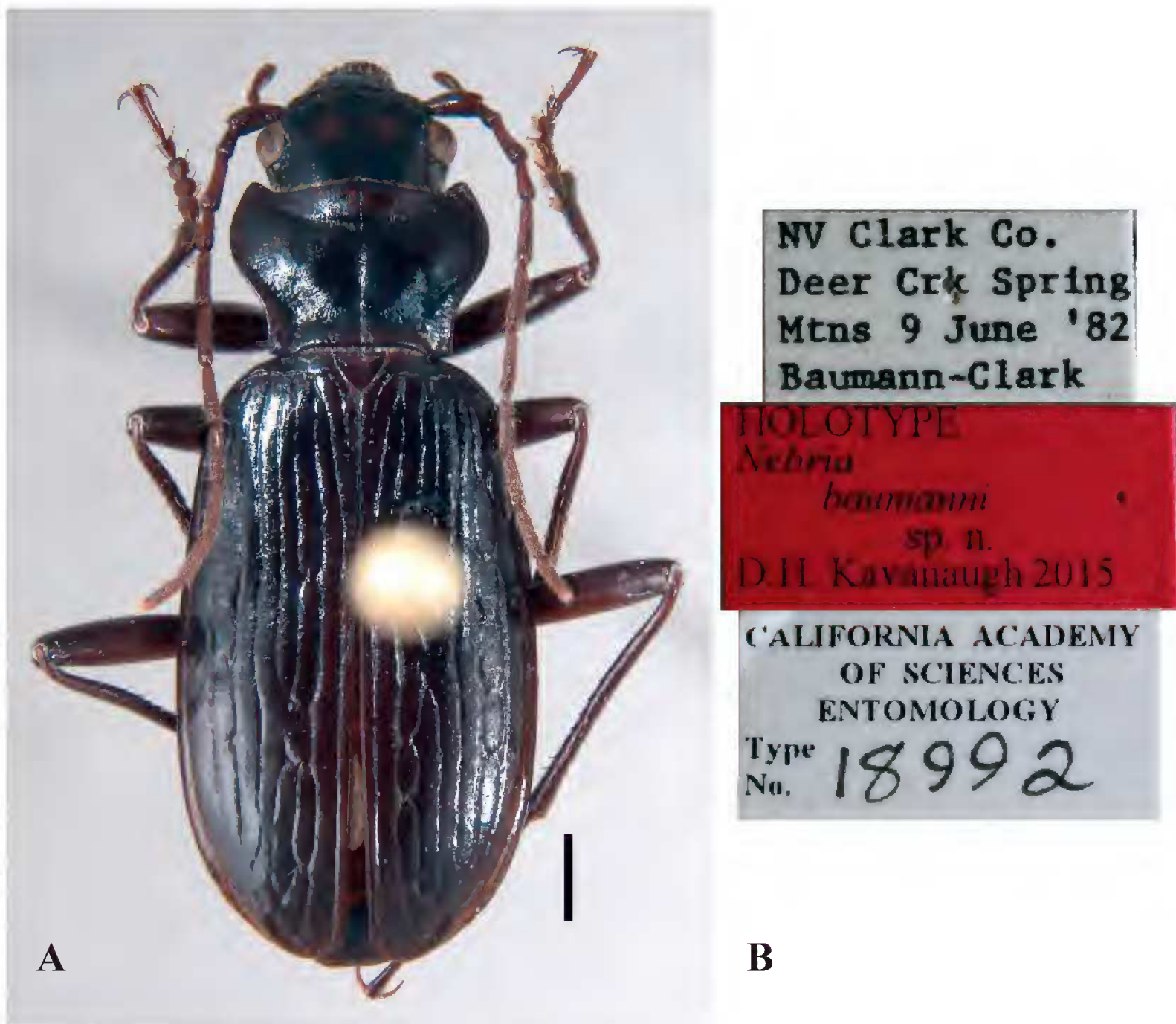


FIGURE 1. Digital images of holotype, *Nebria baumanni* sp. nov. A. Habitus, dorsal aspect; B. Labels for holotype. Scale line = 1.0 mm.

TYPE LOCALITY.— U.S.A., Nevada, Clark County, Spring Mountains, Deer Creek.

DERIVATION OF SPECIES NAME.— It is my great pleasure to name this species in honor of Richard Baumann, who, along with Sean Clark, collected the type series of this species. Throughout his outstanding career, Dr. Baumann and his students have sampled arthropod diversity in the Great Basin and Intermountain regions of the American West more extensively than perhaps any other team. The material that they have collected and made available to others for study, including the specimens described here, have added tremendously to our knowledge of this vast and distinctive region. The species epithet is the Latinized form of his surname name in the genitive case.

DIAGNOSIS.— Adults of this species can be distinguished from those of all other Nearctic *Nebria* species by the following combination of character states: size moderate for genus, SBL of male = 10.4 mm, of females 10.7 to 11.0 mm; body (Fig. 1) black to piceous, dorsal surface without metallic reflection; vertex of head with a pair of paramedial pale spots; elytral microsculpture comprised of moderately impressed isodiametric meshes; antennal scape (Fig. 2A) short, distinctly narrowed basally, widest subapically; pronotum (Fig. 3A) with basal angles rectangular or slightly obtuse, lateral margins with basal sinuation long and deep, sides parallel or slightly convergent basally, with a slight lateral convexity anterior to hind angle in most individuals, lateral

margination (“lateral bead”) obliterated from basal one-fifth (posterior to basolateral sinuation), midlateral and basolateral setae present; elytral silhouette subrectangular, distinctly narrowed basally, widest distinctly posterior to middle, lateral margins nearly straight in basal half, humeral angles obtuse and moderately rounded, humeral carinae absent, elytral apices (Fig. 4A) smoothly arcuate laterally and obliquely truncate medially, roundly angulate apically, paracutellar setiferous pore puncture absent; hindwings long but narrowed; median lobe of male aedeagus with shaft thick, evenly arcuate, apical lamella moderate-

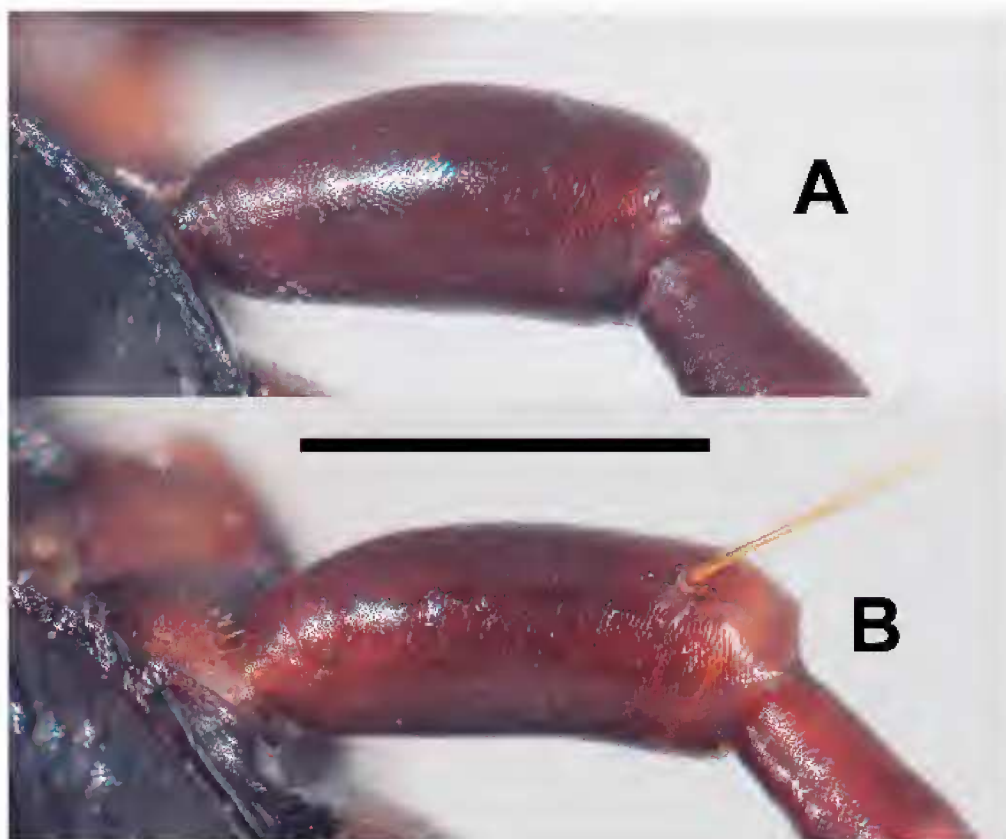


FIGURE 2. Digital images of right antennal scape, dorsal aspect. A. *Nebria baumanni* sp. nov.; B. *Nebria giulianii* Kavanaugh. Scale line = 0.5 mm.

ly long, slightly enlarged and evenly rounded apically in left lateral view (Fig. 5A), shaft distinctly thickened in region of apical orifice in dorsal view (Fig. 5B); bursa copulatrix of female genitalia (Fig. 6A) with a posterodorsal lobe and a distinct bursal sclerite in the posterior wall of that lobe, spermathecal duct inserted at base of the bursal sclerite on posterior face of posterodorsal lobe; specimen from Spring Mountains of Clark County, Nevada (Fig. 7).

Members of this species are most similar externally to those of *Nebria giulianii* Kavanaugh and other members of the *meanyi* species group, with which they share similar overall body form and size (Fig. 1). They differ from members of all the other species of this group in the following features: dorsal elytral surface without metallic reflection (distinct metallic blue, green or violet reflection seen in members of all the other species); antennal scape (Fig. 2A) short and markedly narrowed basally (scape longer and not or only slightly narrowed basally (Fig. 2B) in members of all the other species); lateral margination (“lateral bead”) of the pronotum obliterated posterior to basal sinuation of lateral margin (lateral margination distinctly defined throughout pronotal length in members of all the other species); elytral apices (Fig. 4A) smoothly arcuate laterally and obliquely truncate medially, roundly angulate apically (broadly and evenly rounded (Fig. 4B) in members of all the other species); median lobe of male aedeagus (Fig. 5A) with shaft thick and apical lamella moderately long and apically slightly enlarged (shaft slender and apical lamella shorter and not apically enlarged (Fig. 5B) in males of all the other species); and bursa copulatrix of female (Fig. 6A) with a posterodorsal lobe and bursal sclerite on posterior face of that lobe (posterodorsal lobe and bursal sclerite absent (Fig. 6B) from females of all the other species).

See the key below to distinguish adults of *N. baumanni* from those of all other species known to occur in Nevada.

SEXUAL DIMORPHISM.— Males and females of this species are similar in size and form and both have two pairs of posterior paramedial setae near the hind margin of sternum VII. The only apparent external difference between the sexes is in the front tarsi: in males the basal three tarsomeres of the protarsi are broad and have dense pads of adhesive setae ventrally, whereas these tarsomeres are slender and without such setal pads in females.

GEOGRAPHICAL DISTRIBUTION.— At present, this species is known only from the upper Deer Creek drainage on the northeastern slope of the Spring Mountains, Clark County, Nevada. It is also the only species known only from the state of Nevada.

HABITAT DISTRIBUTION.— All specimens of the type series were collected under stones along Deer Creek an unspecified distance upstream of a small picnic area just off Deer Creek Road (State Route 158) [Baumann, personal communication].

PHYLOGENETIC RELATIONSHIPS.— Based on characters of external morphology and form and structure of both male and female genitalia, *N. baumanni* is a member of the *meanyi* species group of genus *Nebria* and most closely related to *Nebria giulianii* Kavanaugh (1981) and *Nebria lamarckensis* Kavanaugh (1979).

GEOGRAPHICAL RELATIONS WITH MOST CLOSELY RELATED SPECIES.— The known geographical range of *N. baumanni* is allopatric with respect to the known ranges of all other species of the *meanyi* species group (Fig. 7).

Nebria giulianii is known only from the White Mountains in southeastern Mono County, California; and *N. lamarckensis* is known only from the eastern slope of the Sierra Nevada in southwestern Mono County and northwestern Inyo County, California. The nearest localities of these species to the type locality of *N. baumanni* are about 277 and 297 km ENE, respectively, across several lowland gaps of highly inhospitable habitat. The ranges of *N. meanyi* and *N. sylvatica* (see Fig. 7) are far to the north: the former ranging from the mainland coastal mountains of southeastern Alaska and northwestern British Columbia southward along the Cascade Mountain Range from southern British Columbia to Mount Shasta in Siskiyou County, northern California, the latter restricted to the Olympic Mountains of western Washington and Vancouver Island, British Columbia.

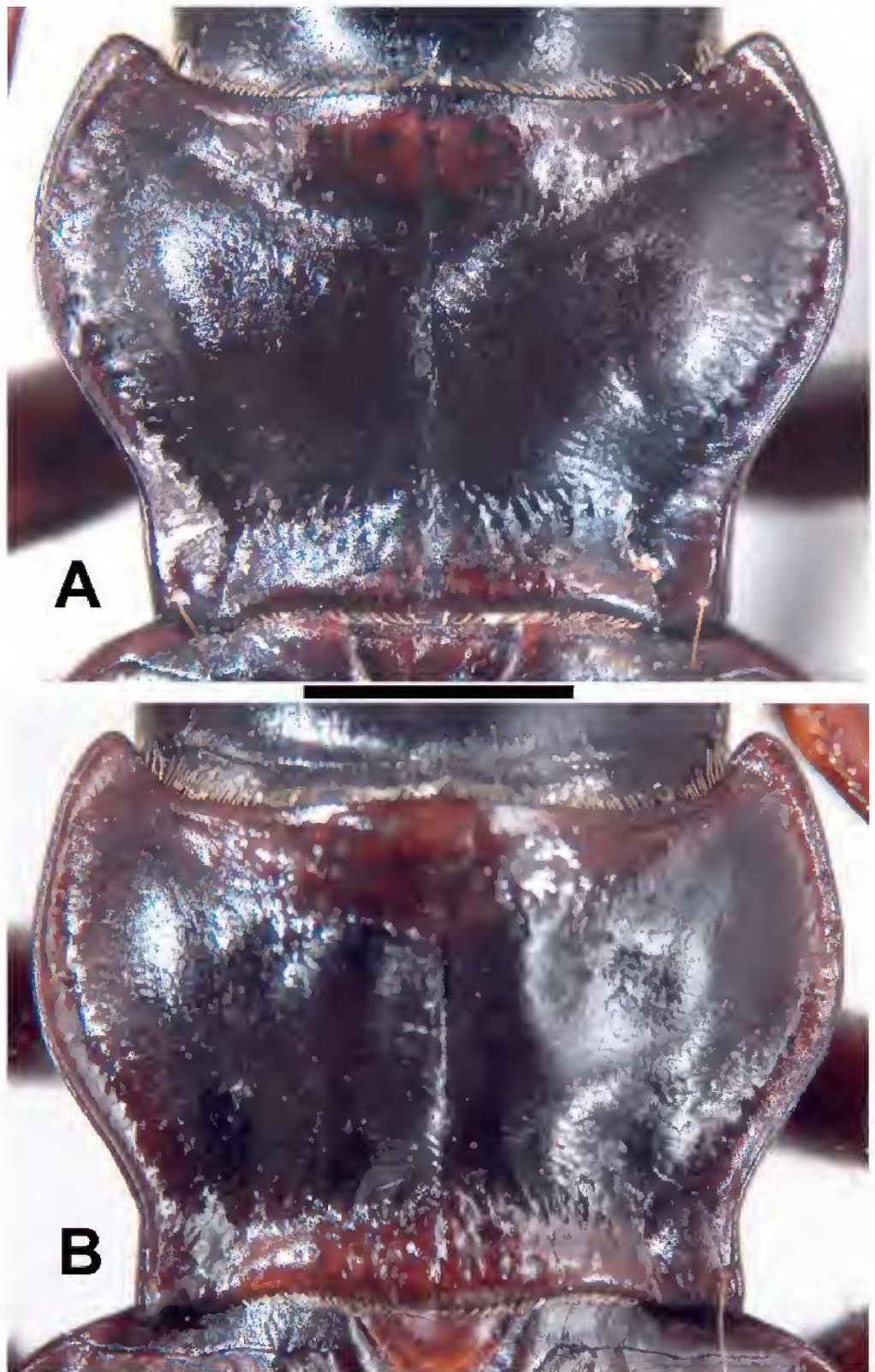


FIGURE 3. Digital images of pronotum, dorsal aspect. A. *Nebria baumanni* sp. nov.; B. *Nebria giulianii* Kavanaugh. Scale line = 1.0 mm.

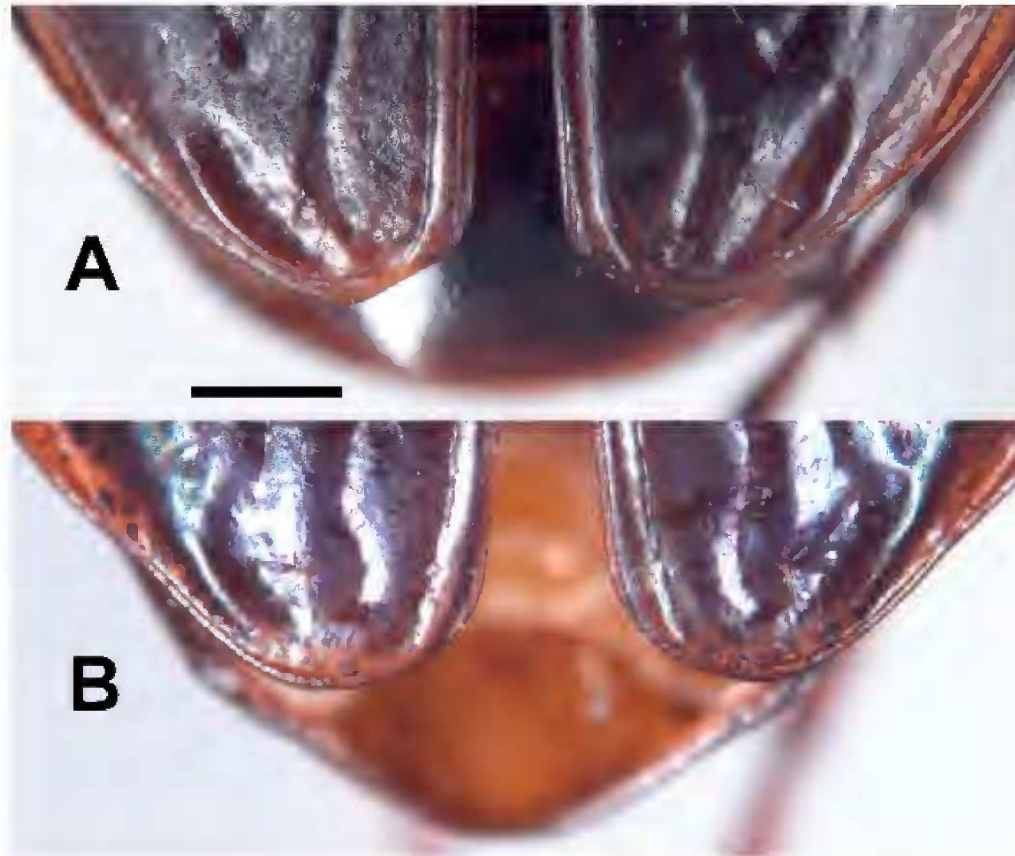
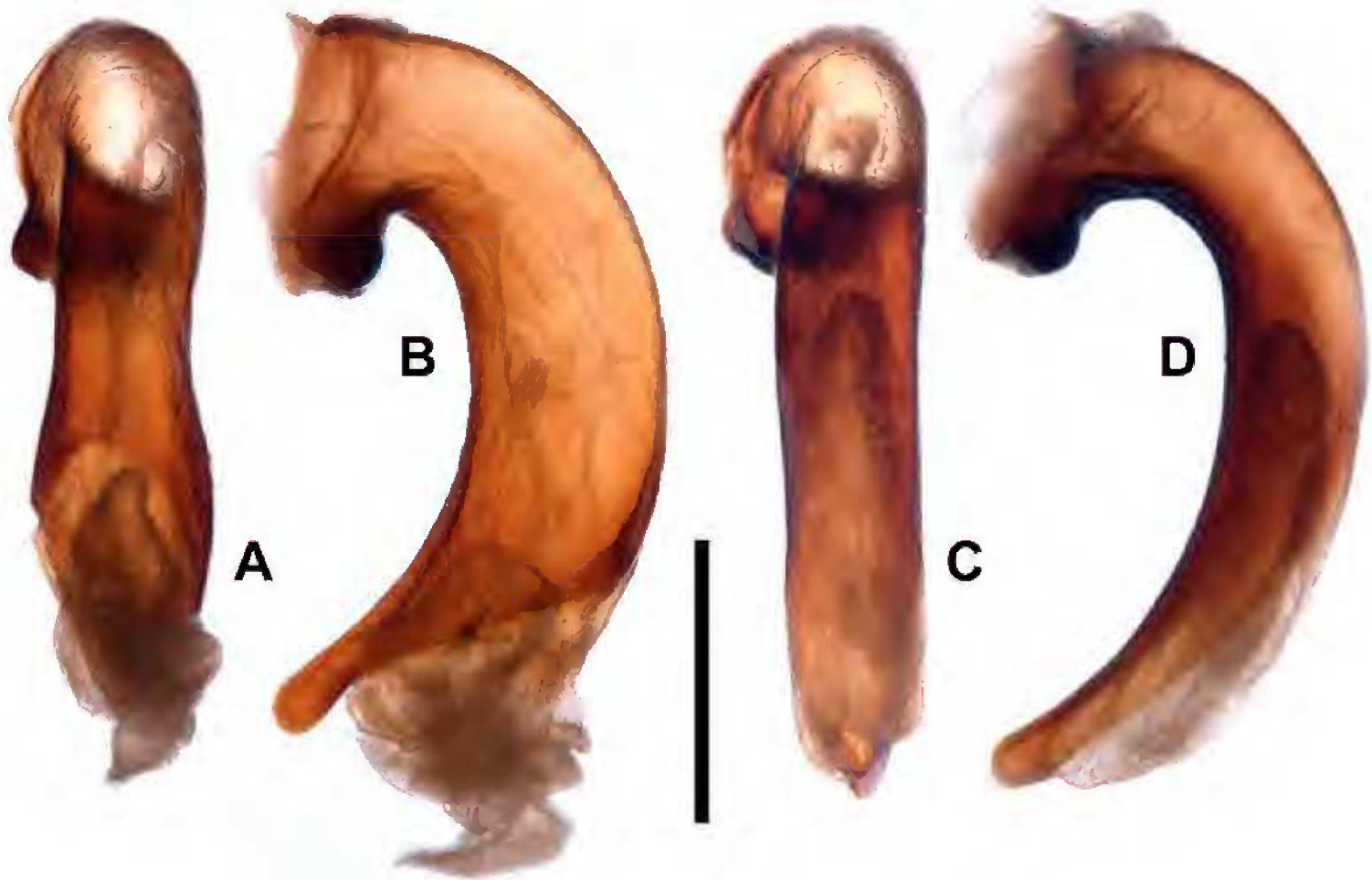


FIGURE 4. Digital images of elytral apices, dorsal aspect; A. *Nebria baumanni* sp. nov.; B *Nebria giulianii* Kavanaugh. Scale line = 0.5 mm.



FIGURES 5. Digital images of median lobe of male genitalia. A-B. *Nebria baumanni* sp. nov.; C-D. *Nebria giulianii* Kavanaugh; A and C. dorsal aspect; B and D. left lateral aspect. Scale line = 1.0 mm.

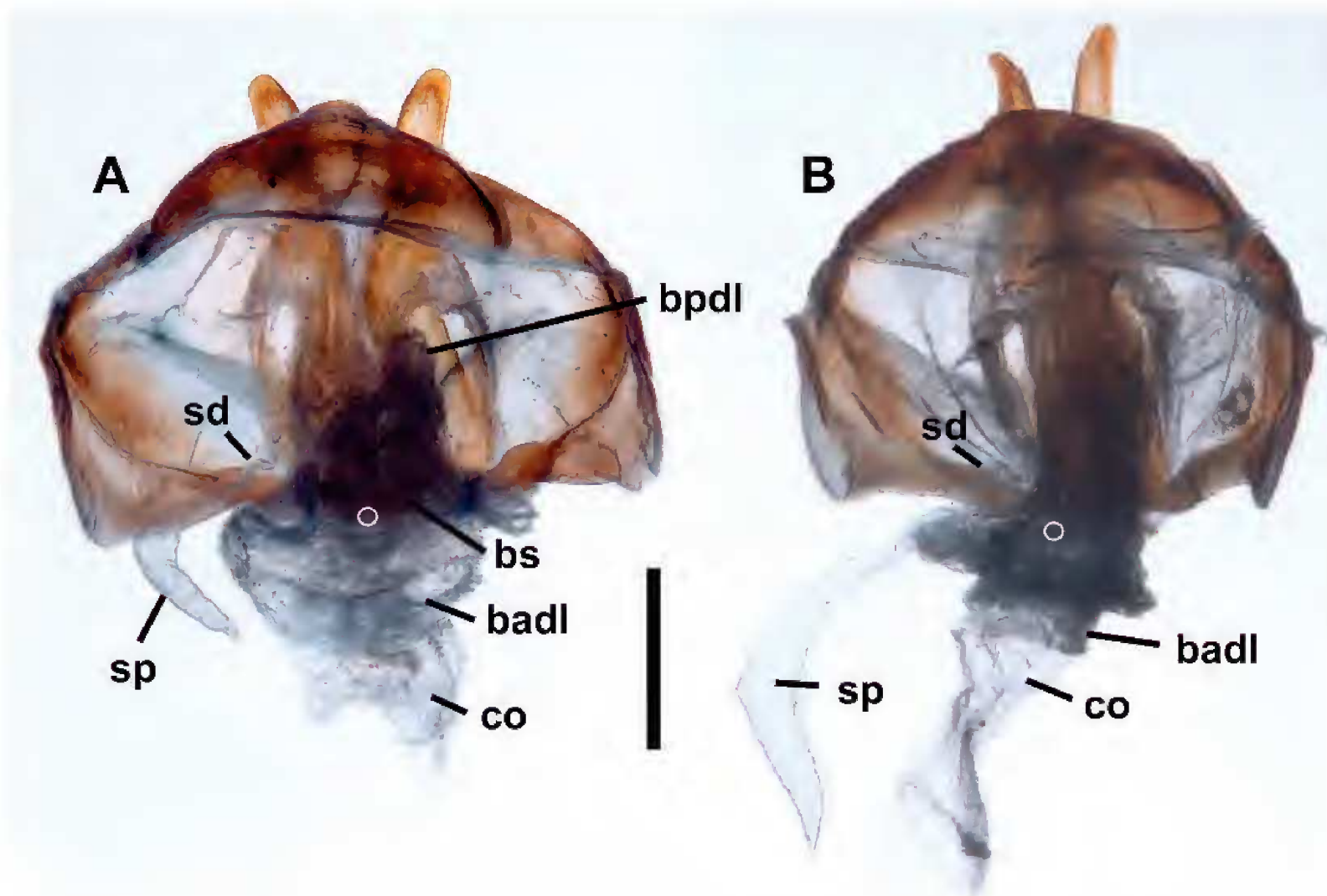


FIGURE 6. Digital images of female reproductive tract, dorsal aspect. A. *Nebria baumanni* sp. nov.; B. *Nebria giulianii* Kavanaugh; badI = anterodorsal lobe of bursa copulatrix; bpdI = posterodorsal lobe of bursa copulatrix; bs = bursal sclerite (in posterior wall of posterodorsal lobe); co = common oviduct; sd = spermathecal duct; sp = spermathecal reservoir; white circle = insertion point of spermathecal duct (at base of posterior face of dorsal lobe). Scale line = 0.5mm.

A Key for Identification of Adults of *Nebria* Species Known to Occur in Nevada

- 1 Head without pale spots on the vertex (to date recorded only from Elko County, Ruby Mountains) *Nebria castanipes* (Kirby)
- 1' Head with a pair of pale reddish spots on the vertex 2
- 2(1') Pronotum with basolateral setae present but midlateral setae absent. 3
- 2' Pronotum with both midlateral and basolateral setae present. 5
- 3(2) Leg color black to rufopiceous (to date recorded only from Elko County, Ruby Mountains) *Nebria edwardsi* Kavanaugh
- 3' Leg color pale yellow or tan-orange 4
- 4(3') Pronotum with lateral margin not or only faintly sinuate anterior to obtuse hind angle, lateral explanation moderately broad (widespread in state). *Nebria oblique* LeConte
- 4' Pronotum with lateral margin slightly but distinctly sinuate anterior to rectangular hind angle, lateral explanation moderately narrow (to date recorded only from Washoe County) *Nebria eschscholtzii* Ménériés
- 5(2') Elytral silhouette distinctly ovoid; antennal scape short, thick, ovoid, symmetrical or more convex anteriorly, not narrowed basally; (to date recorded only from Washoe County, Mount Rosa area) *Nebria ovipennis* LeConte
- 5' Elytral silhouette subrectangular or subovoid; antennal scape short to moderately long, varied in shape 6

- 6(5') Antennal scape moderately long, oval and slightly more convex anteriorly, not narrowed basally; elytral silhouette subrectangular; body small to medium-size, SBL males 8.9 to 10.4 mm, females 8.6 to 10.9 mm (to date recorded only from Washoe County)
. *Nebria rathvoni* LeConte
- 6' Antennal scape short or moderately long, slightly to markedly narrowed basally; elytral silhouette subrectangular or subovoid, body medium- to large-sized, SBL males 10.4 to 12.2 mm, females 10.6 to 13.4 mm 7
- 7(6') Elytral silhouette subovoid, lateral margins more or less arcuate throughout, widest at or slightly posterior to middle; antennal scape moderately long, slightly to moderately narrowed basally; body medium- to large-sized, SBL males 10.5 to 12.2 mm, females 10.6 to 13.4 mm (to date recorded only from Elko County, Jarbridge and Ruby Mountains)
. *Nebria trifaria* LeConte
- 7' Elytral silhouette (Fig. 1) subrectangular, narrowed and with nearly straight lateral margins in basal half, widest distinctly posterior to middle; antennal scape (Fig. 2A) short, thick apically and markedly narrowed basally; body medium-sized, SBL male 10.4, female 10.7 to 11.0 mm (to date recorded only from Clark County, Spring Mountains)
. *Nebria baumanni* Kavanaugh, sp. nov.

COMMENTS

I have spent the last four and a half decades collecting and studying *Nebria* in western North America. During that period, I have had the opportunity to visit repeatedly many montane sites throughout the region. At every one of these sites, I've recorded the same trend — an upward retreat of the lower limit of the altitudinal range of the species that occur there. The magnitude of this retreat is monumental — an average of about 300 meters for essentially every species examined (unpublished data, manuscript in preparation). Because members of all North American *Nebria* species of which I am aware are cold- or at least cool-adapted general predators, I cannot account for such a region-wide and multispecies phenomenon in any way except for climate warming during the past 40+ years.

The beetles described here as a new species were collected just over 33 years ago, and it will be interesting to see how high one must go to find them now, if their habitat exists there at all. I hope that they can still be found extant in the Spring Mountains, and that documenting the existence of this endemic species for the first time will stimulate biologists in the region to look for them.

ACKNOWLEDGEMENTS

I thank Kipling W. Will (University of California, Berkeley) for making the specimens described herein available to me for study from among material that he had borrowed from the Monte L. Bean Life Science Museum, Brigham Young University. I thank Sean Clark and Richard Baumann at BYUC for approving that loan and also for their notes and recollections concerning the collecting of the type series back in 1982. They also approved the deposition of the holotype and one paratype in the collection at CAS. I also want to thank two reviewers, Terry Erwin and Michele Aldrich, for their helpful comments.

FIGURE 7 (right). Map illustrating known localities for members of the *meanyi* species group of *Nebria*; black diamond = *N. baumanni* sp. nov.; black square = *N. giulianii* Kavanaugh; black triangle = *N. lamarckensis* Kavanaugh; black dot = *N. meanyi* Van Dyke; inverted black triangle = *N. sylvatica* Kavanaugh. Scale line = 300 km. Based on "USA Region West landcover location map" from Wikimedia Commons, available at https://upload.wikimedia.org/wikipedia/commons/2/2e/USA_Region_West_landcover_location_map.jpg.



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